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CONTENTS

AN INTRINSIC ANALYSIS OF THE NEW NIGERIAN CHEMISTRY CURRICULUM

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SYNOPSIS

This paper analyses the intrinsic qualities of the new Nigerian Chemistry Curriculum introduced in 1985 all over the Senior Secondary Schools of Nigeria. The new Chemistry curriculum was seen as revolutionary - although it shares the same rationale as the science curricular dinosaurs of the 1960s. A major issue raised by the analysis concerns the extent to which the Chemistry curriculum presents clear specifications of intended purposes, and the methods through which it is hoped to achieve its aims.

This should provide further guidance in refining the extent to which the science curricular guidelines could be made more effective in providing satisfactory educational experiences for pupils in Chemistry.

INTRODUCTION

The early 1960s and 1970s saw massive science education reform activities in both developed and developing countries aimed at a more functional interpretation of science education for pupils at all levels of education. The predominant reform strategy focused attention on the nature of the science curriculum, and many science teaching projects were initiated with the aim of re-evaluating the contents of science teaching programmes and the way they are taught at both primary and secondary schools. Various accounts of these projects were given in different countries, ranging from Japan to Malawi. Detailed and specific case study examples include those given by *Imahori* (1980), *Sapianchai* and *Chewpreccha* (1984), *Lewin* (1981), *Za'rour* and *Jirmanus* (1977), *Millar* (1981), *Hondebrink* (1981), *Moss* (1974) and *Ste-Marie* (1982).

Nigeria was one of the many African countries that also embarked on the science curriculum reform process, along with the rest of the world in the 1970s. One of the outcomes of the science curriculum reform process in the country was the development of the Nigerian Secondary Schools Science Project, NSSSP, by the Comparative Education Study and Adaptation Centre (CESAC) of the University of Lagos, Nigeria.

Before the development of the NSSSP materials, Nigerian secondary schools were using, as a curriculum, a British-oriented examination outline developed and examined by the West African Examinations Council, WAEC, which is a regional examination body for the whole West African subregion. It was to make science teaching and learning more revolutionary and less examination-oriented in Nigerian schools than the WAEC syllabus suggests that the NSSSP was developed.

The NSSSP materials, in Biology, Chemistry and Physics, were used in selected trial secondary schools that have the facilities required to implement it throughout Nigeria in the 1970s at senior school level (from Forms III to V). Other non-trial schools used the standard science curriculum produced by the WAEC. The NSSSP materials shared quite similar rationale found in most of the post-sputnik science curricula then characteristic of science curricular reform particularly in developing countries. For instance, as explained by one of its developers,

> In the NSSSP, the conceptual approach, which makes use of a theme that runs through the entire course has been used in designing the project. Instead of the usual lecture method followed by separate practicals, a new teaching approach, the discovery method, is suggested. To this end, active students' participation through experimentation and discussion, with the teacher playing the role of a leader and not a preacher, is advocated. (Ivowi, 1982 p. 9 and 10).

In 1981, the Nigerian Federal Government introduced a new National Policy on Education which replaced the former British inherited system of education in Nigeria. Under the new system, which has a 6-3-3-4 structural formation and which is common to most Asian countries, primary schooling lasts for six years, secondary schools were divided into two tiers comprising a three-year Junior, and three-year Senior Secondary School. A standard university degree lasts for 4 years. The Senior Secondary School stage of the new policy was implemented in 1985.

With this implementation, the Nigerian government discarded the WAEC curriculum now considered obsolete to contemporary developmental needs, and adopted the NSSSP materials for use throughout the Senior Secondary Schools of Nigeria. This was because of the feeling among government circles that curricula materials such as those of the NSSSP provide a more direct indication of a future developing society with science as its backbone. Moreover, the adoption saves the trouble of developing a whole new curriculum; especially as the NSSSP materials had been on trial for over a decade at the time they were adopted on a national basis.

This paper analyses the intrinsic qualities of the newly introduced science curriculum, with specific reference to Chemistry, drawing attention to its qualities that might prove problematic in interpretation by teachers in the classroom, especially in the way intended by the curriculum developers. The choice of Chemistry is purely random, and serves to illustrate the general nature of the whole science curriculum in Nigeria (for a more detailed and general analysis of the whole science curriculum, see *Adamu*, 1989b).

The analysis is guided by the following research questions:

1. What are the most significant features of the Chemistry curriculum in Nigeria?
2. What is the emphasis of the Chemistry curriculum used in the Senior Secondary Schools in relation to the aims of the curriculum?

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Thus the analysis in this paper attempts to identify the most fundamental characteristics of the Nigerian Chemistry Curriculum, and determine the extent to which the intended aims of the curriculum are reflected in stated desired learning performance objectives of the curriculum as they relate to individual topics in Chemistry.

METHOD OF STUDY

The main analytical focus of this paper is the statement of performance objectives as contained in the Chemistry curriculum. The analysis was not carried out using any specific analytical scheme, although it follows the broad pattern developed by *West* (1974, 1975). The West scheme was developed to carry out a summative evaluation of a curriculum (the Nuffield Chemistry Project; see West, 1974) whose stated aims and suggested teaching strategies were quite similar to those stated in the Nigerian Chemistry curriculum materials.

But because in Nigeria the term "curriculum" is used to refer only to the Chemistry Syllabus guide-lines, the analysis in this paper is necessarily limited by the lack of any other materials associated with large scale curriculum development such as specified teachers' guides, or pupil text materials to accompany the curriculum when it was introduced into the Senior Secondary Schools in September 1985.

The methodological strategy involved counting the individual performance objectives listed in the Chemistry curriculum and allocating each stated objective into a category of learning behaviour. This is to determine which behaviour that particular performance objective encourages in the learner, using the leading word of the stated objective as a guide. It is expected that using this framework, at the end of the analysis a pattern of the most frequent behaviour encouraged by the curriculum developers and communicated to the pupils through teachers' interpretation of the curriculum will emerge. This should make it easier to determine if the aims of learning the subject are reflected in the individual statement of performance objectives of the subject.

The learning categories used as a framework were those developed in Bloom and Krathwohl (1956). These learning categories divide learning according to specific domains of behaviour. These are Cognitive, dealing with mental processes; Psychomotor, dealing with motor skills; and Affective, dealing with emotive behaviour.

GENERAL FEATURES OF THE CHEMISTRY CURRICULUM

An analysis of the general characteristics of the new Chemistry curriculum as contained in the syllabus guide-lines reveals its mechanism. The first significant point was in detailing its structure where its developers explained:

> The topics are organized into instructional units which are sequences in spiral form with each unit treated in greater detail as the course progresses. (NERC 1985 p. ii).

But the most ambitious aspect of the new Chemistry curriculum lies in its suggested teaching techniques, which reflected its post-sputnik heritage. As further stated by its developers:

> It is recommended that the guided discovery approach, resting on the activity of the pupils be used in teaching. (NERC 1985 p. ii).

These two main structural characteristics, juxtaposed with the general objectives of the Chemistry curriculum provided the main analytical framework for this study. The aims of Chemistry curriculum were listed as:

"The objectives of the Chemistry curriculum are to:

1. facilitate transition in the use of scientific concepts and techniques acquired in Integrated Science with Chemistry
2. provide the students with basic knowledge in chemical concepts and principles through efficient selection of content and sequencing
3. show chemistry in its inter-relationships with other subjects
4. show chemistry and its link with industry, everyday life, benefits and hazards
5. "provide a course which is complete for pupils not proceeding to higher education while it is at the same time a reasonably adequate foundation for a post-secondary chemistry course." (NERC 1985 p.ii).

AIMS TO OBJECTIVES

These aims are translated in the Chemistry curriculum through a four-matrix structure in which each topic is divided into performance objectives, content, activities, and notes for the teacher.

The performance objectives list the expected behavioural changes a pupil should undergo as a result of learning that topic. They carry the main essence of the curriculum since they embody the aims of the entire Chemistry curriculum. The activities provide the medium through which the performance objectives can be attained by the students and list the experiments and projects they are expected to carry out. The contents provide the main substance of the topic, while notes for the teacher - rather sparse - provide additional information and guide-lines for the teacher about the topic.

Also, the entire Chemistry curriculum is thematically organised around the major concepts of energy, periodicity, and structure. Each block of concepts is arranged in such a way that it appears in one form or another across the three years of the Senior Secondary School. This is in consistence with the "spiral" plan of the curriculum.

The main drawback to this arrangement is the treatment of all the concepts with the same currency. Moreover, no emphasis is placed on which years the more difficult concepts need to be treated. It also assumes all the concepts can be learnt equally across the years.

THE EMPHASIS OF THE PERFORMANCE OBJECTIVES

The performance objectives in Chemistry were analysed to show the expectations of its developers according to the three domains of learning behaviour - cognitive, psychomotor and affective. This enables judgments to be made about the relative emphasis of the Chemistry curriculum, and the extent to which it reflects its overall aims - which are more politically derived.

The distribution of the performance objectives of the Chemistry curriculum is shown in Figure 1.

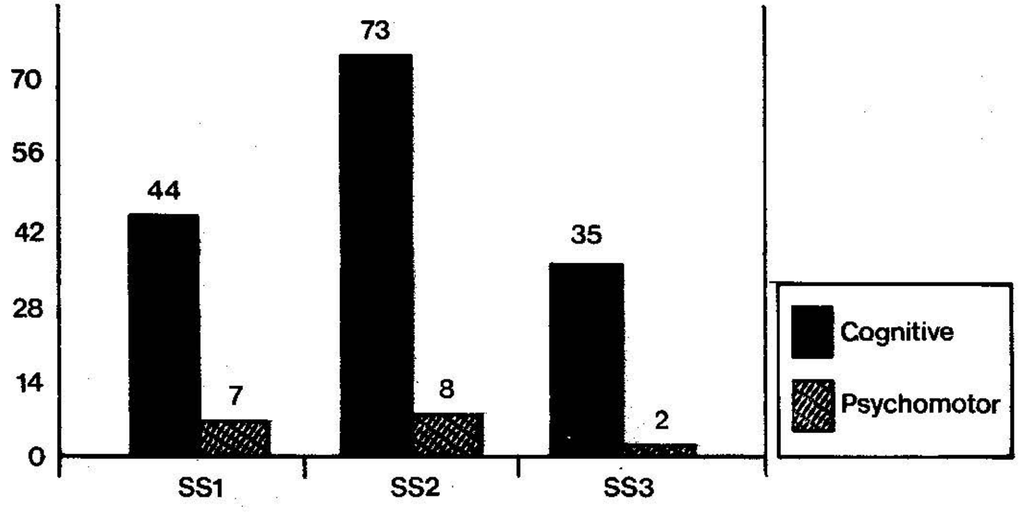

Figure 1. Performance objectives in the new Nigerian chemistry curriculum

From Figure 1, most of the performance objectives seemed to be stated in the cognitive domain throughout the three years of the Senior Secondary School Chemistry Curriculum. Interestingly, for a curriculum that is "activity-oriented", there seemed to be little attention paid by its developers to writing performance objectives which reflect the students' active involvement with learning science expected of the other domains of behaviour, such as the psychomotor domain.

Though probably not intended to encourage emphasis on acquisition of cognitive behaviours most frequently assessed in the final examination (as, for instance, analysed by Adamu, 1989a), an overall small number of psychomotor objectives, as well as the total absence of affective objectives might be thought to encourage precisely this behaviour, which the new Nigerian science curriculum, including the Chemistry guide-line, sets out to eliminate, or at least, reduce.

A further feature of the curriculum is the lack of clarity, precision and consistency with which leading words were used to describe the performance behaviours expected from the students.

For instance, in Year 1 (SS1), a performance objective states "students should explain how the ions in the ionic crystal structure of sodium chloride are held together" (p. 3). In Year 3 (SS3), another objective states they should be able to "explain the importance of petroleum to Nigerian economy" (p. 21). It is clear in both these instances the "explaining" requires a different emphasis in each case, yet the wording does not reflect this, and shows the inconsistency with which the word is used in the Chemistry curriculum. This is not an isolated case, and similar instances are encountered throughout the curriculum.

It is therefore argued that such ambiguity could prove confusing to teachers who take the curriculum at its face value.

A second level analysis was further carried out on the distribution of the performance objectives placed in the cognitive domain category. This is to determine which specific intellectual skills within the cognitive domain the distribution of the performance objectives in the Chemistry curriculum encourages. The results of this analysis are summarized in Figure 2.

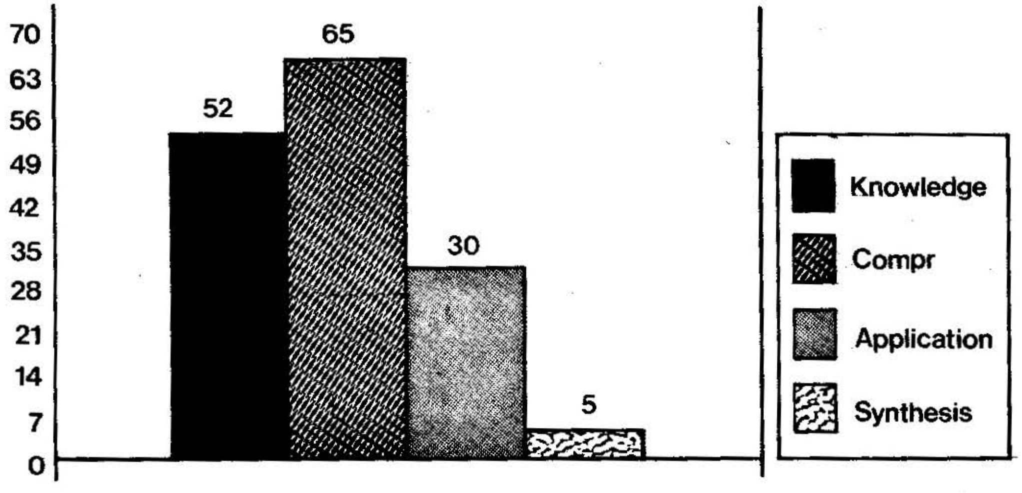

Fig. 2. Cognitive objectives in the new Nigerian chemistry curriculum

Thus even within the cognitive domain, there is an uneven distribution of the performance objectives; with Knowledge (52) and Comprehension (65) domains being close to each other, and few objectives stated in such a way to encourage the development of higher order skills such as Application (30) and Synthesis (5).

Indeed a considerable latitude was given during the categorisation of the performance objectives as Comprehension. Quite a number of the objectives stated the student should "describe ...." or "recognize that ...." without making it quite clear the context of either description of the recognition. For instance, an objective states that students should be able to "explain the effect of temperature and pressure together on a given volume of gas" (p. 4); while another one states that students should "describe the nature of the proton in aqueous solution" (p. 5). In situations such as this, it becomes hard to assign certain performance objectives into either the "knowledge" or "comprehension" domain of cognitive behaviour.

Thus the emphasis of the Nigerian Chemistry curriculum would seem to be on the acquisition of basic scientific knowledge. Other traits most commonly associated with learning science, and as declared in the rationale of the curriculum, such as the development of specific attitudes were not emphasized, while the acquisition of scientific techniques associated at school level with the development of the Synthesis and Psychomotor domains, among others, were found only to a limited extent.

These emphases would seem to be recurrent in cases where a more social rationale is given as a basis for science education programmes. For instance, Lewin (1981) carried out a similar analysis of the Malaysian Integrated Science curriculum materials whose major intentions were to reduce emphasis on the recall of factual information in favour of encouraging the development of affective, psychomotor and higher order cognitive skills. And yet despite this intention:

> it is surprising to find that 53% of section objectives are specified at the knowledge level of the cognitive behaviour whilst only 18% of general objectives are. (Lewin 1981 p. 179).

CONCLUSIONS AND IMPLICATIONS

The analysis of the curriculum emphases of the Chemistry curriculum materials in Nigeria highlights the main features of the curriculum and focuses attention on its aspects which are likely to prove difficult to interpret in the way the curriculum developers intended. The absence of quite many coherently stated performance objectives, as well as the lack of precision, in their statements must inevitably result in some degree of confusion in interpretation by those teachers who use the curriculum as the basis for their teaching. A major issue raised by the analysis therefore concerns the extent to which the Chemistry curriculum presents clear specifications of intended purposes, and the methods through which it is hoped to achieve its aims.

This has direct consequence for teachers, who are generally expected to translate accurately into specific learning behaviours the intentions of the curriculum developer. With a curriculum that does not provide clear specifications of its intentions, it is quite possible for the wrong messages about science to be subsumed by pupils.

Interestingly, while Nigeria is struggling to implement a post-sputnik science curriculum, the emerging pattern in the international science curriculum development in the late 1980s is a departure from the package-deal approach that characterised the curricular reforms of the 1960s. This was in part brought about by rapid social and economic changes which brought with them critical re-appraisal of the post-sputnik science programmes. In the United States, consistent criticism of the programmes in the early 1970s led to evaluation studies as reported by Stake and Easly (1978), and Kahl and Harms (1981). In Canada the re-appraisal process was initiated by the Science Council of Canada leading to a three-volume analysis of science education in Canadian schools which paints a rather depressing future for the 1990s (Orpwood and Souque 1985, and Ste-Marie 1982). In England, the Association for Science Education lent its voice to the growing crisis of confidence in the post-sputnik science curricula with a series of rather radical curricular alternatives with strong emphasis on the philosophy and social dimensions of learning science (ASE, 1979).

And earlier on, developing countries, especially those in Asia which had adopted or adapted overseas (American or British) curricula were, by 1969,

> experiencing considerable difficulties in their use, as was reported by delegate after delegate at the joint UNICEF-UNESCO regional workshop on planning for science teaching improvement in Asian schools, held in Bangkok, Thailand, in 1969. (Maddock 1981 p. 5).

In Africa, Yoloye and Bajah (1980) also reported similar problems with the implementation of a continental Science Education Programme for Africa (SEPA) which was a post-sputnik attempt at revolutionising the teaching and learning of science, especially in African primary schools.

It is clear therefore that a second wave will soon engulf the science education community bringing with it further messages about the role of science curriculum in human affairs in the 1990s. Developing countries such as Nigeria need to evaluate the impact of the emerging trend and ride with the waves.

In the meantime, to make further judgments about the extent to which the school realities of the newer science curricula (referring to, in most developing countries, the post-sputnik programmes) match their structural rhetoric, more investigations need to be carried out to determine the way the curricula are interpreted by teachers in the classrooms, and the role of extraneous factors, such as examinations, on their interpretation of the curricula. This should provide further guidance in refining the extent to which the science curricula could be made more effective in providing satisfactory educational experiences for pupils in Chemistry.

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